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ABSTRACT

The emergence of the digital campus, and the rapid convergence of previously disparate methods of communicating information, presents both a risk and an opportunity for people with disabilities. The imminent risk is that non-inclusive design of the digital campus will irreparably widen the digital divide within higher education, to the detriment of learners and educators with disabilities as well as to society as a whole. The opportunity is to use emerging tools and technologies to create more learner-directed, flexible, multi-modal learning environments, thereby reducing barriers and advancing education for all learners. This paper presents the perspectives of two centers of expertise on inclusive teaching and learning: ATRC (the Adaptive Technology Resource Center) at the University of Toronto, and Project EASI (Equal Access to Software and Information), a core activity of the TLT Group, the Teaching, Learning and Technology affiliate of the American Association for Higher Education. Initiatives that reduce barriers and advance educational practice are discussed, and strategies for harnessing the patterns of "converging and emerging" trends to create a more accessible education environment are proposed. (AEF)

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Bridging the Digital Divide in Higher Education

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Abstract

Making the educational experience inclusive of people with disabilities has benefits for all learners. Modifications and enhancements intended for learners with sensory, physical or learning disabilities often make the learning environment more flexible and engaging for students without disabilities. This paper will present several initiatives that promote inclusive teaching and learning, but also advance on-line learning, pedagogically and technically.

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Introduction

The emergence of the digital campus, and the rapid convergence of previously disparate methods of communicating information, presents both a risk and an opportunity for people with disabilities. The imminent risk is that non-inclusive design of the digital campus will irreparably widen the "digital divide" within higher education, to the detriment of learners and educators with disabilities but also to the detriment of society as a whole. The opportunity is to use emerging tools and technologies to create more learner-directed, flexible, multi-modal learning environments, thereby reducing barriers and advancing education for all learners.

This paper will present the perspectives of two centers of expertise on inclusive teaching and learning: Project EASI (Equal Access to Software and Information) and the Adaptive Technology Resource Centre (University of Toronto). Initiatives that reduce barriers and advance educational practice will be discussed. Strategies for harnessing the "patterns of converging and emerging" trends to create a more accessible education environment, will be proposed.

The Adaptive Technology Resource Centre (ATRC)

Description of ATRC

The Adaptive Technology Resource Centre (ATRC) at the University of Toronto is a recognized center of expertise on access to information technology. The mandate of the ATRC is to foster the effective use of adaptive technology and the accessibility of information technology in education. This mandate is met in part through, research, development, consultation, workshops, publications, and participation in international forums. The ATRC assisted in establishing and is an active participant in the Web Accessibility Initiative of the World Wide Web Consortium. The Centre hosts several web sites on accessible teaching and learning. The Centre is also a consortium leader for a number of research projects related to accessible on-line teaching.

Accessible Courseware Authoring

Ever increasingly, education is conducted over the World Wide Web. The majority of curriculum on the web is created using courseware authoring tools or web authoring tools. With very few exceptions current courseware authoring tools produce inaccessible content, provide inaccessible student interfaces and cannot be used by educators with certain types of assistive technology. Accessibility guidelines for developers, utilities to check the accessibility of content and repair curriculum, and comparative evaluations of courseware tools and their products, are all initiatives underway to insure that as many students as possible can benefit from on-line learning opportunities.

Internationally adopted guidelines on how to create Web content that is accessible, is clearly laid out in the Web Accessibility Initiative, Web Content Accessibility Guidelines at http://www.w3.org/WAI. CAST provides a tool that can be used to assess whether content created for the web is accessible, www.cast.org/bobby. The ATRC has developed a tool that will both assist a courseware author in creating accessible courseware and in repairing the content if there are existing access problems. This program is called A-prompt and can be accessed at http://snow.utoronto.ca/aprompt. ATRC is working with courseware developers to integrate A-prompt into popular courseware products. In an area where there are few established principles of best practice, tools such as A-prompt can assist educators in establishing minimal standards of usability.

ATRC is also conducting ongoing evaluations and comparisons of courseware authoring tools and making these results available over the web. The evaluations consist of objective benchmarks and subjective ranking by users (both students and educators) who have disabilities.

Access to Science and Math

Most current career growth areas require a firm grounding in math and science. Unfortunately online math and science curriculum is inaccessible to people who are blind or visually impaired. Math notation is presented as graphic images that cannot be read by screen readers or refreshable Braille displays. A number of mechanisms are under development that allow the expression of math and science notation over the web in editable form.

MathML is a proposed markup system for math on the web. When adopted, MathML would allow math notation to be expressed on the web in an editable form that can be deciphered by text readers such as screen readers and Braille displays. At present while there are programs to convert MathML to LaTex, and programs to convert LaTex to Braille and speech, there is no system that makes it easy for a user of a refreshable Braille display or a Screen Reader to read MathML. Through funding from the Telecommunication Access Partnership Program of the Ontario government, ATRC is working to expedite this process, see http://www.utoronto.ca/atrc/rd.html. ATRC is also working with MathML viewer and editor developers to make their products accessible.

At present demonstrations, simulations and experiential learning exercises rely upon graphics, animation and video, and require manipulation using a mouse. This excludes a large number of students who cannot see or who cannot use a mouse. By adding modalities, such as the sense of touch and audio as speech and real world sounds, to these simulations and by allowing learner control of the experience through a number of input mechanisms, the experience is both more accessible to people with disabilities and more engaging and meaningful for all learners. Through several projects, the ATRC has worked to add haptics, or the sense of touch and tactile manipulation and audio, to interactive courseware. One example of haptic enhanced courseware includes a multimodal Periodic Table that illustrates the relative properties of elements, such as weight, through the sense of touch. Another example is a Haptic Pendulum model that

illustrates the properties of a pendulum using a haptic device. Haptics and audio has also been used to communicate geographic structures and their spatial relation in multi-modal on-line maps.

Educating and Supporting the Educators

The ATRC established and maintains a web site intended to educate and support educators of students with disabilities. SNOW (http://snow.utoronto.ca) provides on-line professional development courses on accessible teaching, accessible curriculum, models of best practice, a comprehensive list of on-line, forums to consult experts and forums for peer discussions. (This project is partially funded by the Ontario Ministry of Education and Training).

Converging Technologies

With the emergence of broadband networks, educational television is exploring the delivery of interactive courseware over the Web. This poses the challenge of adopting a new paradigm for learning without abandoning the wealth of rich educational resources previously developed. In partnership with Canadian Learning Television and several other public and private sector partners, the ATRC is exploring the use of access tools such as captioning and video description as the basis for interactive learning. Thus, when watching a recorded lecture by Einstein on physics, if Einstein uses a word the student does not understand the student can select the word in the verbatim captioning and receive a definition of the word. If the student wants further illustration of a concept discussed she would again click on the word in the captioning and move to an interactive exercise or other illustrative material on-line. These interactive exercises can include the ability to feel forces, contours and textures through haptic devices. The student would also have the ability to adjust the captioning and video description to customize the type and level of assistance they desire. Thus the video description during a chemistry experiment could be verbose: labeling and describing each of the chemicals manipulated, if this is not already being done by the lecturer. The reading level or language of the captioning could be adjusted, thereby supporting second language learners and literacy development. Advanced captioning could be activated. This would allow captioning using any multi-media object as a video layer. Thus items can be labeled and highlighted, sign translation can be added, speakers can be identified and the paralinguistic elements of the audio can be better communicated. (This project is partially funded through Canarie, Inc.)

The Challenge of Multi-User Workstations and Smart Cards

One of the challenges faced by educational institutions is to provide barrier-free access to public or student workstations. Each student approaching the workstation may have individual preferences or needs regarding the workstation configuration. The administrative management and technical upkeep required to accommodate all these preferences is often prohibitive. Assistive technologies required by students with disabilities may complicate this further as the software programs often conflict with other

applications and each other. The ATRC in conjunction with Devmark Inc., the Royal Bank and Once Corporation has designed a smart card system that allows users to instantly configure workstations by storing their personal preferences on a smart card. When the card is inserted into the smart card reader attached to the workstation, the preferred assistive technology is launched, personal preferences are set, the appropriate system tools are configured, and the preferred browser is launched and configured individually. When the smart card is removed the system is reset to the default setting. These smart card systems are presently being piloted at several sites across Canada.

EASI

Description of Easi

EASI (Equal Access to Software and Information) has adopted a motto: *"Students and professionals with disabilities have the same right to access information and resources as everyone else."* EASI is a core activity of the TLT Group, the Teaching, Learning & Technology affiliate of the American Association for Higher Education.

EASI's mission is to serve as a resource to the education community by providing information and guidance in the area of access-to-information technologies by individuals with disabilities. We stay informed about developments and advancements within the adaptive computer technology field and spread that information to colleges, universities, K-12 schools, libraries and into the workplace. Our supporters and friends comprise people from colleges, universities, businesses and other institutions. They include computing staff, disabled student services staff, faculty, administrators, vendors, representatives of professional associations, private consultants, heads of both non-profit and for-profit organizations, as well as faculty and staff from K-12 schools.

Collect and Disseminate Information

EASI has been awarded three grants from the National Science Foundation to collect and disseminate information about how to assist students and professionals to succeed in the fields of science, math, engineering and technology. EASI began making careful use of the Internet as the primary means to reach as many schools and colleges as possible for the least expense. Listserv discussions can be a waste of time, or they can be powerful tools to network with people with similar to your own. EASI's major list is easi and runs from a listserv at St. John's University (easi@maelstrom.stjohns.edu). In the early 90s EASI initiated axslib-l@maelstrom.stjohns.edu as a list for librarians to help them make their facilities more accessible to patrons with disabilities. After a short flirtation with Gopher, EASI made its real home on the web at http://www.rit.edu/~easi on a site generously supported by the Rochester Institute of Technology.

The first thing EASI has done as a result of the NSF grant was to highlight the work being done by other NSF award recipients in this field which includes research, development and demonstration projects. The NSF Program for Persons with Disabilities has sponsored over three dozen projects. A project based at Oregon State University

directed by John Gardner has developed a Braille embosser that does a superior job of handling both Braille and raised dot and raised line drawings. It also has developed software that functions as a graphing calculator using sound to simulate the graph. The Georgia Institute of Technology is developing tools and techniques to make science labs more accessible for students with disabilities. This work is directed by Karen Milchus. DO-IT (Disabilities, Opportunities, Internetworking and Technology), based at the University of Washington and directed by Sheryl Burgstahler, selects promising high school students who have disabilities and have an interest in science and has a program to work with them and their teachers to prepare them for transition to University. It also prepares faculty at the University of Washington to accept these students in their courses.

Access to Science

The National Science Foundation quickly realized that students with disabilities were not being prepared in grade and high school for the sciences. Frequently, these requirements were waived, or the teachers just moved them along without making them learn the material. It sponsors several grants in K-12 primarily aimed at helping to prepare the teachers. Special education teachers lacked the science knowledge, and the discipline teachers lacked understanding of the needs of special students. Some of these grants sponsored by NSF include The New Jersy Institute of Technology, The University of Delaware, New Mexico State Universit and the university of Hawaiiy. EASI has continued helping to disseminate the results of these schools as well. One of EASI's other Internet dissemination tools is the juried e-journal, Information Technology and Disabilities. Three issues of this journal have focused on science access and largely described the NSF grant projects. The journal can be found at http://www.rit.edu/~easi/itd.htm. Relevant material is on the web at http://www.rit.edu/~easi/easisem.htm

Collaborative Research and Development

EASI is actively cooperating with several other groups. The University of Southern Maine has a Department of Education grant to help train graduate education students nation-wide about adaptive computer technologies and their helpfulness for students with disabilities. Utah State University has a LAAP grant that focuses on training university web designers on how to design web pages to be more accessible. The National Center on Accessible Media at WGBH Boston is working in conjunction with the Massachusetts Institute of Technology to make an online physics video course accessible to students with various disabilities, and EASI is supporting this activity.

Distance Education

EASI has an interest in distance learning. It delivers two online workshops over the Internet. One is on adaptive computing for colleges, and the other is on creating barrier-free web pages. Http://www.rit.edu/~easi/workshop.htm

Over a decade ago a survey sponsored by NSF found that the major barrier to students with disabilities succeeding in the sciences in school was "negative social attitudes". This continues to be true today. EASI's third NSF grant focuses on the use of Internet multimedia as a dissemination tool. EASI believes that media is a powerful tool for persuasion. It is clear that providing new information and new tools are important, but changing social attitudes and raising social awareness is still basic. EASI has been posting half an hour of fresh audio or video to its web site almost weekly. Hearing a student describe how adaptive technology has changed his learning is powerful. Hearing a researcher describe his motivation and his work is also attention-getting. EASI's uses of media will expand in the next two years.

The other purpose of EASI's media involvement is to demonstrate ways that Internet media can be provided in accessible formats. For the most part this is a matter of thoughtful planning and careful execution. The major hurdle that arises is providing caption text for videos or PowerPoint slide presentations. SMIL (synchronized multimedia integration language) is a tool that permits a media producer to stream video, audio and synchronized captions simultaneously over the Internet. MAGpie is a software program developed by NCAM and the Trace Research and Development Center to facilitate this process. Even with its help, providing Internet captioning is mildly complicated, requires great patience and takes a lot of time. EASI does this regularly and is launching a captioning service for educational institutions.
http://www.rit.edu/~easi/captions.htm

Relevant Legislation

Recently several pieces of legislation have come into effect that govern the accessibility of educational curriculum to people with disabilities. This may affect all institutions of higher learning.

In a meeting of distance learning professionals where a high-paid Washington lawyer spoke, the audience became irritated at his lack of specificity. They were worried about the law and its impact on them. They wanted to know how to keep out of trouble. The lawyer then confessed that "no one knows exactly what impact the Americans with Disabilities Act will have on distance learning, and (he) didn't know either." He noted that laws speak in general terms. Court cases and decisions define what those generalities mean for given situations. The audience found this to be little comfort. In this vein, we can refer to legislation and to some court decisions, but each case is unique and no one can guarantee how a judge will rule in a specific situation.

The Vocational Rehabilitation Act (1973) in section 504 specifies that students with disabilities must have equal access to educational programs. This does not specify access to computers as that was almost irrelevant back then. One school recently provided a human reader to read the monitor to a blind student instead of providing adaptive technology access. Many court cases in the last decade strongly insist that access to programs means access to information technology. They also state that equal access does not mean having it inter-mediated through a reader. Now that half of the courses in the

United States integrate the Internet in some way into the class material, access to programs has to involve access to information technology. The Department of Education Office for Civil Rights has stated that providing adaptive technology is similar to providing ramps to buildings.

The Americans with Disabilities Act (1990) has a different focus. It is civil rights legislation. Title II is most frequently invoked especially in public institution cases. One clause that is frequently sited is the need to provide alternative communication "that is as effective as" communication with others. Originally, this applied to oral communication and interpretation for the Deaf. The courts then stated that print is a form of communication and that an alternative to print must be found for students with various print disabilities. The court quickly expanded print to mean digitized information as well. Access to electronic documents and to web pages has been covered in several cases.

Another frequent phrase taken from Title II is "in a timely manner". The courts recognize that providing a textbook and a one-page class memo are different and impose different time frames. In the case of class handouts, the court has stated that means at the same time as handed to other students. For texts the court still wants urgency but will think in terms of a few weeks. However, when school terms only last 10-15 weeks or so, providing a text at the end of a course is not considered timely.

Section 508 of the Vocational Rehabilitation Act was re-authorized in 1998, and its regulations are presently being finalized. This mandates that Federal agencies purchase only equipment, software, and such that is accessible to people with disabilities or which can be readily made accessible. This has shocked many large hardware and software vendors as the Federal government is a significant market. Many are convinced that "Federal agency" has a very broad meaning. It is widely believed that any state accepting funds from the Technology Assistance Act (which includes all of them) will have all of its state agencies included, and some states already have indicated that public universities and colleges will be covered. If so, this will require that web pages be designed according to universal design principles. It will also require universities to create a process to scrutinize its software and hardware purchases.

As was stated in the introduction to this section, each case is different. We cannot guarantee how it would apply to you if a problem arose. We have pointed out the directions in which the winds are blowing. Prevention is always better than a cure. Proper design from the ground up is always better and cheaper than retrofitting.

Conclusion

A pattern that repeats itself throughout the history of technological development is that innovations and accommodations made for people with disabilities benefit many people without disabilities. Technological development motivated by access for people with disabilities has resulted in such critical tools as the telephone, email, and voice recognition. We can take advantage of the emerging/converging environment we find

ourselves in to create educational experiences that are inclusive and beneficial to all learners. If we miss this opportunity we may find that as institutions of higher learning we have irreparably widened the digital divide that marginalizes up to 15% of learners and educators who have disabilities.

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Abstract

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